(12) UK Patent Application (19) GB (11) 2 090 952 A

(21) Application No 8135641
(22) Date of filing 26 Nov 1981
(30) Priority data
(31) 3100321
(32) 8 Jan 1981
(33) Fed. Rep. of Germany (DE)
(43) Application published
21 Jul 1982
(51) INT CL³
C21B 7/10
(52) Domestic classification
F4B 114 NB
(56) Documents cited
EP 0021919A
(58) Field of search
F4B
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(54) Mounting of cooling means in a furnace

(57) For securing a plate cooler (1) on the inside of the jacket of a metallurgical furnace, protective tubes (5) fixed to the cooler are arranged to surround coolant tubes (2) in the region of passage of the tubes through openings (7) in the furnace jacket (6). The protective tubes are provided externally of the furnace jacket with holding plates (11) and pipework to seal the openings against the escape of gases. In one horizontal plane (3) of the plate cooler (1), at least one protective tube is constructed as a fixed mounting (8), i.e. it is firmly welded to the jacket by means of the holding plate. The further protective tubes at the same level are constructed as horizontally displaceable mountings (10) with the holding plates (11) welded to the protective tubes only so that they slide in a guide (12) on the furnace jacket to prevent thermal expansion of the cooler. In another horizontal plane (4) at a position opposite to the fixed mounting (8), at least one protective tube is constructed as a vertically displaceable mounting (13), while the other protective tubes at this level are constructed as loose mountings (14) displaceable both vertically and horizontally.

Fig. 1

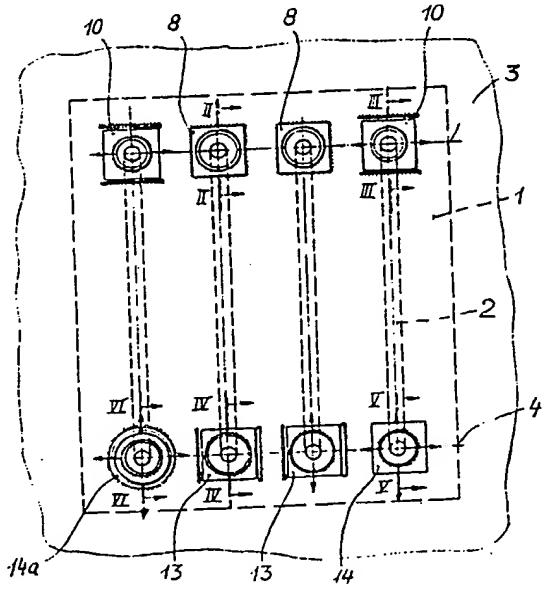

Fig. 3

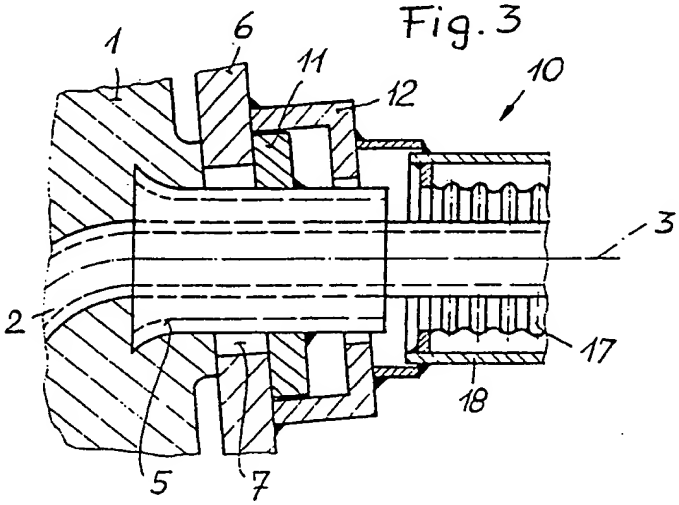

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Fig. 1

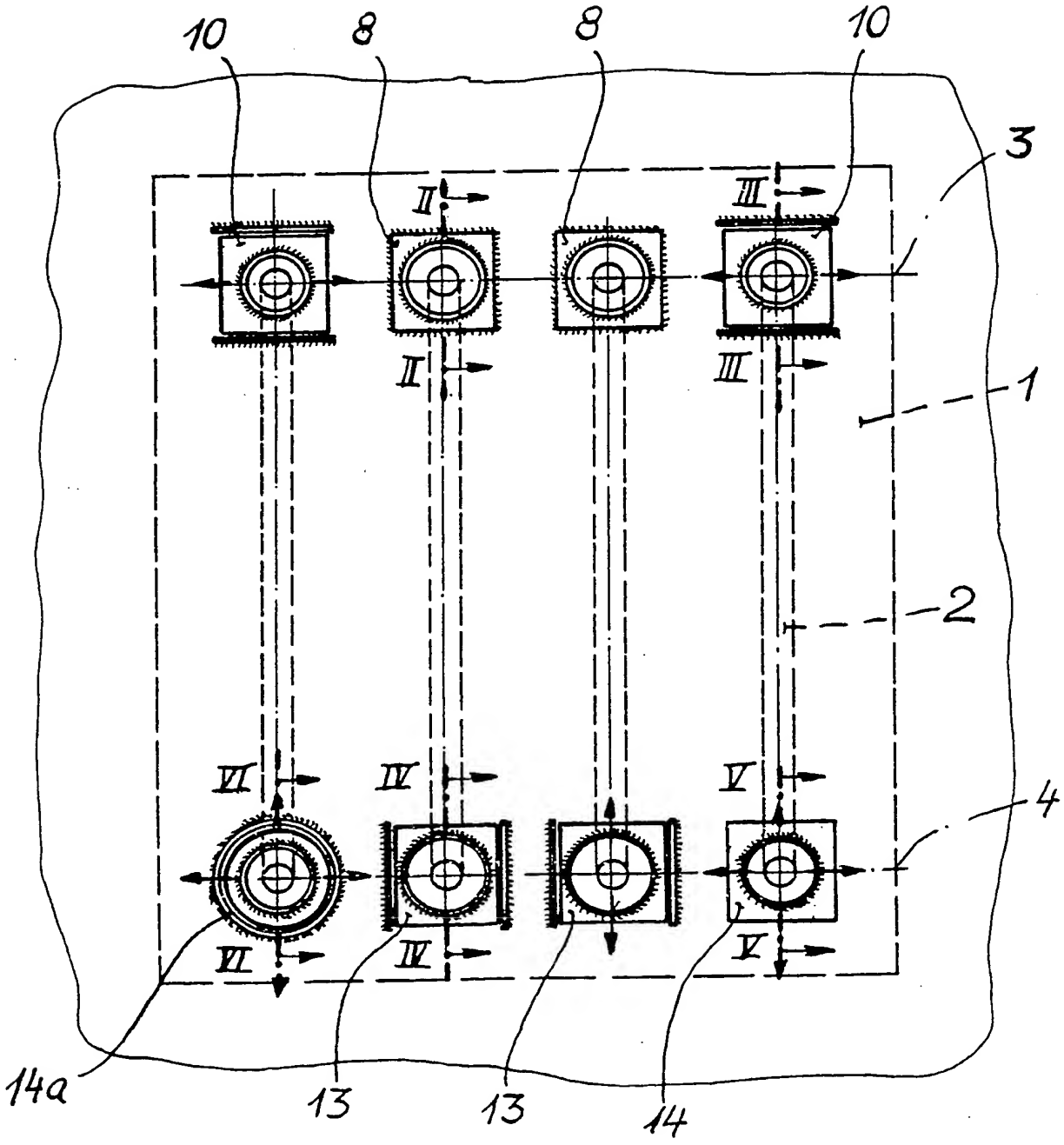

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Fig. 2

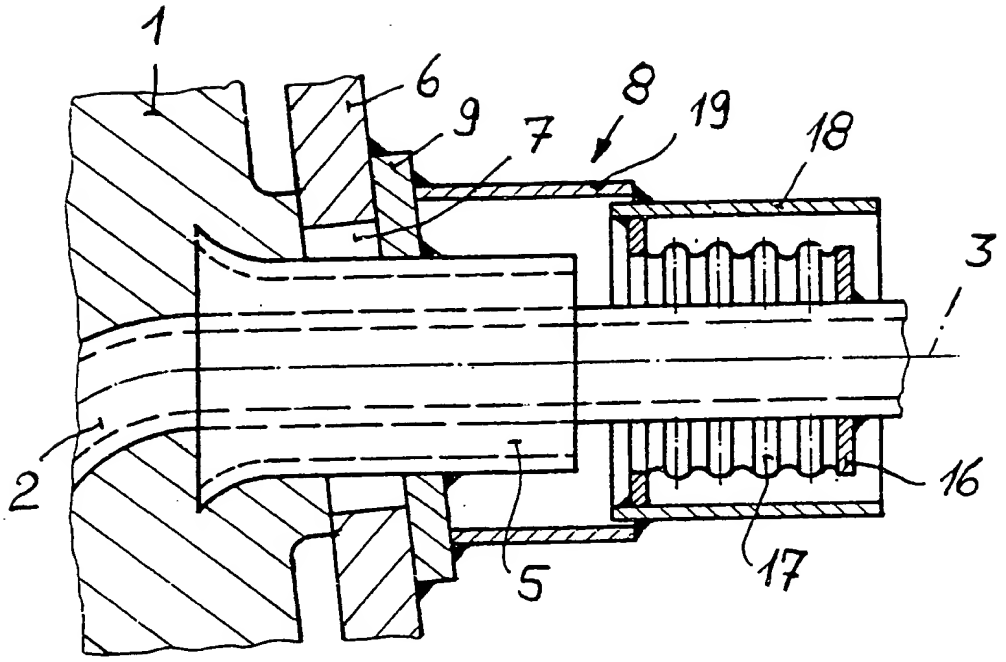

Fig. 3

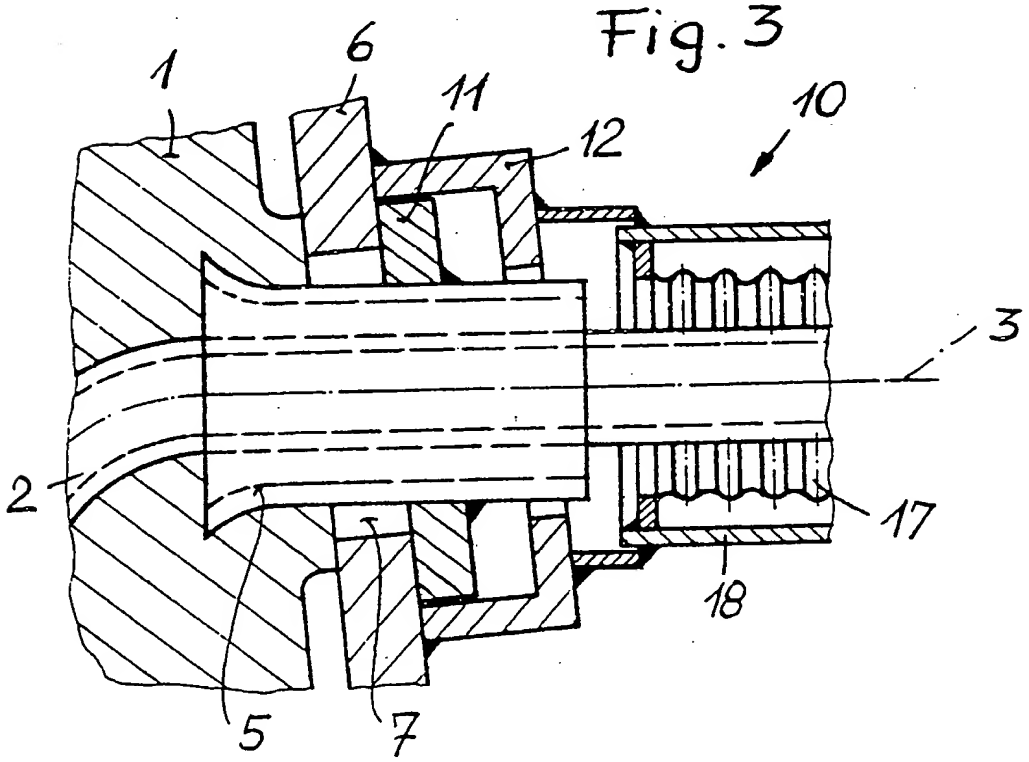

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Fig. 4

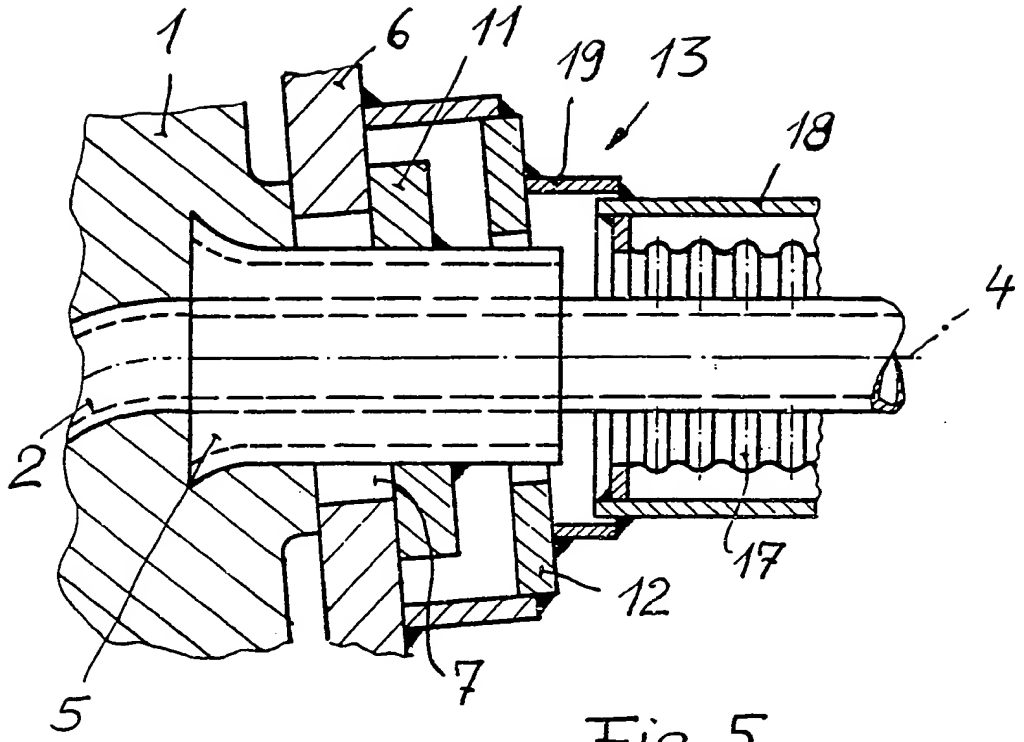

Fig. 5

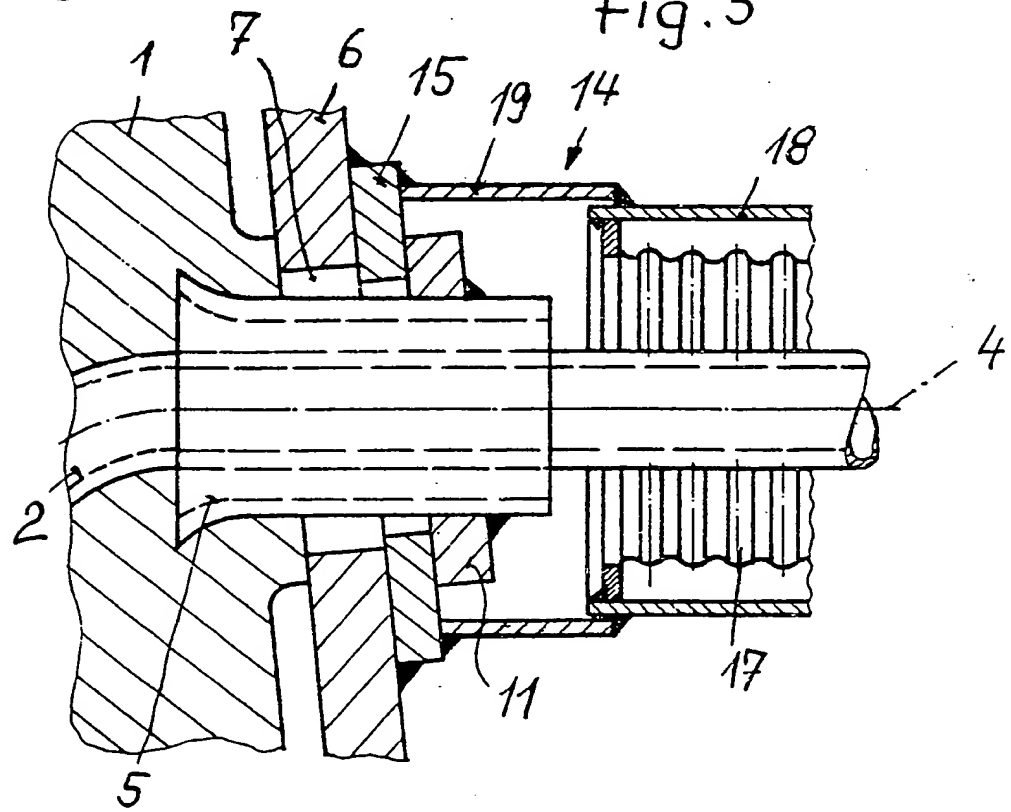

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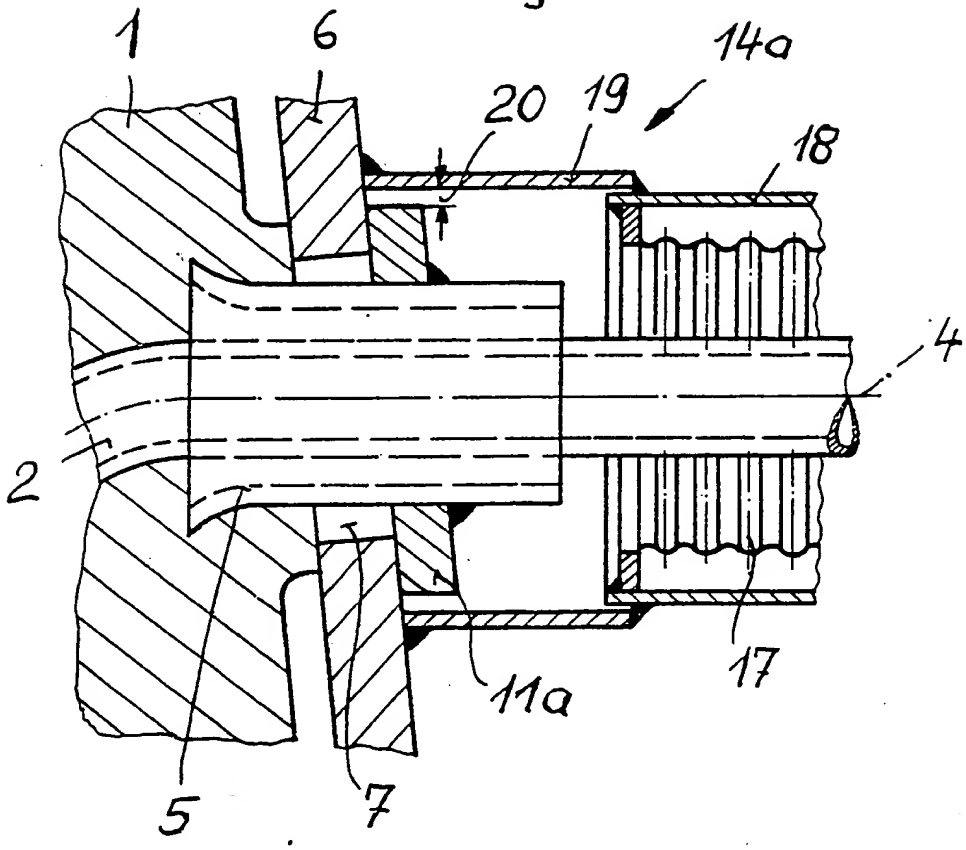
Fig. 6



SPECIFICATION

Mounting of cooling means in a furnace

The present invention relates to the mounting of cooling means in a furnace, especially a plate cooler in a metallurgical furnace, such as a blast furnace.

The plate coolers of a blast furnace cooling system have hitherto been fixed in various ways to the internal face of the furnace jacket or shell. One known form of fixing provides an almost rigid connection of the plates by firm welding of protective tubes surrounding the coolant tubes of the cooler to holding discs or sealing hoods, which in turn are welded to the furnace shell. Due to alternating stresses imposed on the plate coolers at differing heat outputs from the interior of the furnace, the aforementioned welding locations are subjected to alternating strains which can lead to fracture and thus leakage of gas from the furnace.

In another method of fixing, which is described in German (Federal Republic) patent specification (Offenlegungsschrift) No. 27 43 380, the plate coolers are held by means of bolts which are pushed through the plate coolers and firmly screwed into the furnace shell. The head of each bolt is sunk into a recess in the inner face of the shell. At the outside, the nut for each bolt is sealed by a sealing hood.

At high heat loadings of the plate coolers, the fixing bolts are subjected to unacceptably high strain or the bolt heads even melt away. As a consequence, the plates can move towards the centre of the furnace. Hot reaction gas flows through the gap between the plate coolers and furnace shell and heats up the shell to an unacceptable extent. The protective tubes come into contact with the walls of the openings in the shell for the coolant tubes and cause further stress.

There is accordingly a need for a method of mounting cooling means to a furnace whereby thermally induced forces acting on the cooling means do not generate unacceptable constraints at the fixing locations, the cooling means remain firmly anchored in place notwithstanding the action of external forces caused by expansion of adjacent plates or b y material situated in the furnace, and the coolant tubes remain unchanged in position relative to the furnace shell or jacket even if the castings of the cooling means crack as a consequence of continuing temperature fluctuations. In addition, gas should be prevented from escaping between the cooling means and furnace shell, the movement of external piping of the cooling means should be as small as possible, and reliable sealing of openings in the furnace shell should be provided.

According to the present invention there is provided a furnace provided at an inner face of its jacket with cooling means having cooling tubes which pass through openings in the jacket at two levels, respective mounting means being provided at each of said openings to mount the cooling means relative to the jacket and comprising a protective pipe section, which is fixed to the cooling means and surrounds the associated coolant tube at a spacing therefrom in the region of the passage of the tube through the jacket, and sealing means sealing each said opening against the escape of gas through the mounting means, the mounting means being so constructed and arranged that at one of said levels of openings at least one of the mounting means secures the associated coolant tube against movement relative to the jacket while the remaining mounting means at that level are adapted to permit horizontal movement of the associated tubes relative to the jacket, and at the other one of said levels the mounting means respectively opposite said at least one of the mounting means is adapted to permit vertical movement of the associated tube relative to the jacket while at least one of the remaining mounting means at that level is adapted to permit movement of the associated tubes relative to the jacket in a plurality of directions.

Preferably, the protective pipe section of the or each securing mounting means is, after passing through the jacket, firmly welded to the jacket by means of a securing plate. A plurality of mounting means arranged alongside one another can be constructed as securing mountings, since the slight thermal strain to be expected when the spacings are relatively small is accommodated by the protective pipe sections.

Such expansion of the cooling means as may occur is compensated for if, at each mounting means permitting horizontal or vertical movement, the respective protective pipe section is provided with a retaining member such as a disc, which is mounted with horizontal or vertical clearance respectively in guide means welded to the jacket. Each mounting means permitting movement in a plurality of directions preferably accommodates both horizontal and vertical displacement and comprises a spacer disc which is welded to the jacket and surrounds the respective protective pipe section with a clearance at its periphery, the protective pipe section being secured against axial displacement towards the centre of the furnace by a retaining element.

Through the provision of horizontally displaceable mounting means in the same horizontal plane or level on either side of the securing mounting means, the result is achieved that the strain that occurs over the entire width of the cooling means is compensated for, but that forces which act from above or below on the cooling means and whcih are too large for the securing mounting means alone to accept, are partly carried by the guide means, so that there is no displacement of the cooling means in the vertical direction. The one or more mounting means accommodating vertical displacement and disposed at the level opposite to the securing mounting means have the effect that thermal strains in the longitudinal direction of the cooling means do not produce constraints as lateral forces resulting from strain in adjacent plates of the

cooling means are transmitted through the retaining member on the respective protective pipe section to the guide means. The remaining mounting means at this level have clearance in both horizontal and vertical directions relative to the spacer disc surrounding them. Thus, no constraints arising from thermal strain of the cooling means can arise in this region. The retaining element welded to the protective pipe section of each such mounting means prevents movement of the cooling means towards the centre of the furnace. Thus the flow of hot furnace gas between the cooling means and jacket is prevented.

With the described construction of the mounting means, the inlet and outlet zones of the coolant tubes are secured in such a manner that the position of each coolant tube remains unchanged relative to the furnace jacket even if cracks occur in the cast plates of the cooling means as a consequence of continual temperature changes.

For sealing the mounting means against escape of gas, a tubular carrier member is welded to the securing plate, the guide means or the spacer disc, as the case may be, of each mounting means and carries an expansible metallic coupling member, which is surrounded by a protective casing and is coupled to the associated tube.

An embodiment of the present invention will now be more particularly described by way of example and with reference to the accompanying drawings, in which:—

Fig. 1 is a schematic elevation of a plate cooler mounted on the jacket of a furnace, showing the various mounting means for effecting such mounting,

Fig. 2 is a cross-section, to an enlarged scale, on the line II—II of Fig. 1, showing a fixed mounting,

Fig. 3 is a cross-section, to an enlarged scale, on the line III—III of Fig. 1, showing a horizontally displaceable mounting,

Fig. 4 is a cross-section, to an enlarged scale, on the line IV—IV of Fig. 1, showing a vertically displaceable mounting,

Fig. 5 is a cross-section, to an enlarged scale, on the line V—V of Fig. 1, showing a mounting permitting movement in a plurality of directions, and

Fig. 6 is a cross-section, to an enlarged scale, on the line VI—VI of Fig. 1, showing another form of mounting permitting movement in a plurality of directions.

Referring now to the drawings, there is shown a plate cooler 1 comprising four coolant tubes 2 which are cast in parallel to one another and which lead out from the casting in two horizontal levels or planes 3 and 4. In the outlet zones, the coolant tubes are surrounded by protective tubes 5, which are also incorporated in the casting and which project from a bearing face of the plate cooler. When the plate cooler is mounted on the inner face of the furnace shell or jacket 6, the coolant tubes 2 and the projecting protective tubes 5 extend through openings 7 in the shell 6. The protective tubes 5 serve for fixing the plate cooler. In the horizontal plane 3, the two central protective tubes 5 are constructed as fixed mountings 8, one of which is shown in Fig. 2. For the fixed mounting, a holding plate 9 covering the opening 7 is firmly welded to the protective tube 5 and the shell 6. Arranged in the same plane 3 and adjacent to the fixed mountings 8 are horizontally displaceable mountings 10, one of which is shown in Fig. 3. In the case, a holding disc 11 is firmly welded to the associated protective tube 5 and is mounted in a guide 12 in such a manner that a facility for expansion exists in and only in the horizontal direction. The holding disc 11 slides on the shell 6.

Arranged opposite to the fixed mountings and in the horizontal plane or level 4 are two vertically displaceable mountings 13, one of which is shown in Fig. 4. Here again a holding disc 11 is firmly welded to the protective tube 5 and is mounted in a guide 12, in this case turned through 90° compared to the guide of the mounting 10. If thermal expansion of the plate cooler takes place in the direction of its longitudinal axis, the holding disc 11 slides in the vertical direction on the shell 6. Also arranged in the plane 4 and on either side of the vertically displaceable mountings 13 are "loose" mountings 14, whereby expansion of the casting is possible both horizontally and vertically. One of the mountings 14 is shown in Fig. 5. In this case a spacer disc 15 is welded to the shell 6 and surrounds the protective tube 5 at its periphery with clearance. A holding disc 11 welded to the protective tube 5 bears against the spacer disc 15 and secures the protective tube against axial displacement towards the centre of the furnace.

Fig. 6 shows a modified "loose" mounting 14a. In this case, a circular holding disc 11a is welded to the protective tube 5 and spaced from a surrounding pipe length 19 by a clearance 20 sufficient to accommodate thermally induced movement of the plate cooler 1. If external forces act on the plate cooler, displacement thereof is prevented by bearing of the holding disc 11a against the inner wall of the pipe length 19.

Since gas from the furnace can pass through the openings 7 in the shell 6 and through the annular gaps at the protective tubes 5, the mounting locations of the plate cooler are sealed. For this purpose, each coolant tube 2 is connected by way of a disc 16 with a metal compensator 17, which is surrounded by a protective casing 18 and is welded in a gastight manner by means of a pipe length 19 to the holding plate 9, to the guides 12, to the spacer discs 15 or directly to the shell 6.

CLAIMS

1. A furnace provided at an inner face of its jacket with cooling means having cooling tubes which pass through openings in the jacket at two levels, respective mounting means being provided at each of said openings to mount the cooling means relative to the jacket and comprising a

protective pipe section, which is fixed to the cooling means and surrounds the associated coolant tube at a spacing therefrom in the region of the passage of the tube through the jacket, and sealing means sealing each said opening against the escape of gas through the mounting means, the mounting means being so constructed and arranged that at one of said levels of openings at least one of the mounting means secures the associated coolant tube against movement relative to the jacket while the remaining mounting means at that level are adapted to permit horizontal movement of the associated tubes relative to the jacket, and at the other one of said levels the mounting means respectively opposite said at least one of the mounting means is adapted to permit vertical movement of the associated tube relative to the jacket while at least one of the remaining mounting means at that level is adapted to permit movement of the associated tubes relative to the jacket in a plurality of directions.

2. A furnace as claimed in claim 1, wherein the protective pipe section of said at least one of the mounting means at said one level is fixed to the jacket at the outer face thereof by means of a securing plate.

3. A furnace as claimed in either claim 1 or claim 2, wherein the protective pipe section of each said mounting means permitting horizontal or vertical movement is provided with a retaining member which is slidably engaged in guide means mounted on the jacket.

4. A furnace as claimed in any one of the preceding claims, wherein said at least one of the remaining mounting means at said other level is adapted to permit movement of the associated tubes relative to the jacket in both horizontal and vertical directions and comprises a spacer element which is secured to the jacket and surrounds the respective protective pipe section at a spacing therefrom, said pipe section being provided with a retaining element co-operable with the spacer element to secure the pipe section against movement inwardly of the furnace.

5. A furnace as claimed in any one of the preceding claims, the sealing means of each mounting means comprising a tubular carrier member secured to means connected to the jacket, an expansible metallic coupling member coupling the associated coolant tube to the carrier member, and a protective casing surrounding the coupling member.

6. A furnace substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1982. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.